UCRL-ID-141955

Plutonium Immobilization Canister Rack & Magazine Preliminary Design

T. Gould, P. Maddux

September 30, 1998

U.S. Department of Energy

Lawrence
Livermore
National
Laboratory

DISCLAIMER

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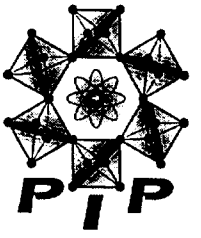
WSRC-TR-98-00333



Plutonium Immobilization

Canister Rack & Magazine Preliminary Design (U)

September 30, 1998

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Plutonium Immobilization
Canister Rack & Magazine Preliminary Design (U)

The following Plutonium Immobilization Can-In-Canister Team members contributed to this report.

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PURPOSE

The purpose of this report is to document our current preliminary design for the Can-in-Canister rack and magazine. Since this is a developmental project with testing still ongoing, these designs will probably change as we become more knowledgeable of the functions, reliability, and cost of these designs.

RACK DESIGN

Function

In the Plutonium Immobilization Project, seven magazines will be remotely loaded through the neck of a DWPF canister and placed into positions determined by an internal framework, or "magazine rack" inside the canister (see attachment 1). The magazine rack serves several purposes: (1) It keeps the seven magazines in a pre-determined, symmetric orientation inside the DWPF canister; (2) The rack provides both lateral and vertical latching to reduce the possibility of magazines leaving their positions; (3) The rack lends strength during canister handling, transportation, and glass pouring; and (4) The rack contributes to non-proliferation by supplying a structural connection for the seven magazines in the glass-metal matrix.

Assumptions & Requirements

A conceptual design for the magazine rack is presented herein. A number of assumptions were used in developing this design, and they are listed below:

1) The rack will be installed inside the DWPF canister during canister fabrication.
2) The rack will hold seven magazines (~3.5" diameter, 87" tall).
3) The magazine will hold four cans (3" diameter, 20" long).
4) Magazine loading will be performed through the neck of the canister using a jointed arm robot.
5) Vertical and lateral latching is required on the magazine rack.
6) Vertical latches are not required at each row of cans. Latches are only required to meet transportation and handling loads. At this time, lateral latches will only be installed at two rows of cans, the first (top) row and the third row.
7) There will be one scalloped plate installed at each can level. One scalloped plate will be provided for each row of cans to provide structural support. The plates also provide a potential increase in proliferation resistance.
8) The rack's mass will be kept to a minimum for thermal considerations.
9) Where possible, the rack will minimize resistance to glass flow.
10) A minimum of 2" of clearance will be provided between the rack bottom plate and the canister bottom.
11) The rack will provide a minimum of 2" of clearance between the magazine o.d. and the canister i.d.
12) No portion of the rack or installed magazine shall exceed a height of 91" which is the minimum procedural fill height for DWPF (as measured from the canister bottom).

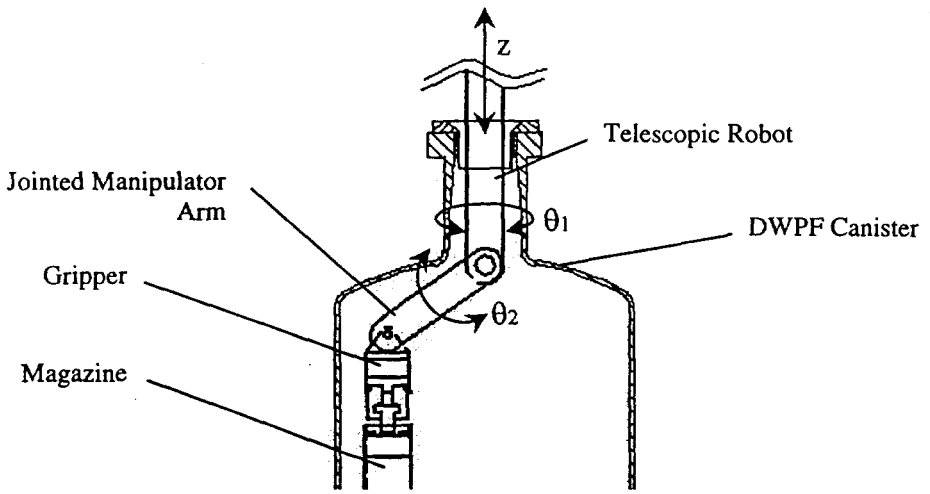


Figure 1. Sketch of canister loading equipment and motions.

To keep the rack light and strong, a framework of horizontal plates connected by vertical support rods was the configuration chosen for the rack design. All parts are made of 304 series stainless steel, which matches the DWPF canister material. There are four scalloped plates and one base plate.

A customer requirement specified the need for one scalloped plate per product can in a magazine. In the current design there are four 20" cans per magazine, thus four scalloped plates are used in the rack design. The scalloped plates are positioned such that they align with the center of each can. The first scalloped plate is positioned roughly 10" above the bottom plate, followed by three more spaced 20" apart.

At the bottom of the rack is the base plate. The base plate carries the weight of the magazines, serves an alignment function for magazines, and provides some magazine lateral stability as a result of the cone-nipple arrangement on the bottom of the magazines. The base plate is supported by seven radial struts welded to the bottom of the base plate. In order to distribute the load of the rack and magazines, and to provide a stable base, the strut's bottom surface matches the contour of the bottom of the DWPF canister. The struts have large openings for glass flow and mass reduction. A 9" diameter hole in the center of the base plate permits unobstructed glass flow to the bottom of the canister. At the lowest clearance location, there is ~3" between the base plate and the bottom of the canister.

The plates are connected by seven vertical ¾" solid stainless steel rods which are positioned between magazine locations. The rods start at the radial struts on the bottom, and end just above the top most plate. Holes are drilled in the plates to allow the rods to pass through, and the plates are welded to the rods at the proper axial location.

One purpose of the rack is to provide some type of lateral latching that keeps the magazines in a vertical orientation during handling and transportation. Several lateral latching concepts were

6. Each magazine must be remotely loaded with cans and remotely installed into the rack inside the DWPF canister.
7. Cans are not required to be individually restrained within the magazine.
8. The magazine interior must be amenable to cans remotely sliding into place.
9. The magazine exterior must be amenable to remote insertion through a protective funnel in the DWPF canister neck.
10. The mechanical strength of the magazine must be adequate to allow remote handling of the magazine loaded with product cans.

Features

The magazine is shown on attachment 5. Either 3" Sch 10 stainless steel pipe or 3.5" x .120 wall tubing is the material of construction for the barrel. The slots are either cut or milled into the barrel side wall using laser, plasma torch or milling machine. Alternate manufacturing methods are being evaluated. Both ends are machined from 304 SS solid stock. The "cone end" of the magazine is held into place with a snap ring to retain the cans after they have been placed in the magazine. The top mushroom end is fixed permanently and is used for remote handling. The magazine ID is 3.25" nominal to provide clearance for ease of loading and for maximizing glass flow between the magazine and can walls.

Design History

Canister loading with magazines loaded with product cans was identified early in the project as the preferred method for loading the product cans into the DWPF canister. SRTC and NMSS identified and evaluated over 20 concepts (ref.1 & 2) for loading product cans into the magazine. After carefully analyzing all the concepts, EES chose a rigid magazine as the best method to remotely load cans into DWPF canisters.

To ensure the feasibility of "through the throat" magazine manipulation inside a DWPF canister, SRTC conducted a remote loading test using a test magazine constructed of 3" Sch40 pipe and having prototypic loaded weight and overall dimensions. This successful test yielded the current designs for the magazine's mushroom top and "cone in cup" bottom.

Two methods to insert cans into magazines were developed: (1) end loading and (2) side loading. End loading requires cans to be pushed into a horizontal or vertical magazine and secured by snapping on either the magazine top or bottom piece. Side loading magazines have a door through which each can is inserted into an inclined magazine and then allowed to slide into position motivated only by gravity. After the last can is in place, the loader snaps the door closed. SRTC also considered magazine construction and identified three possible forms:

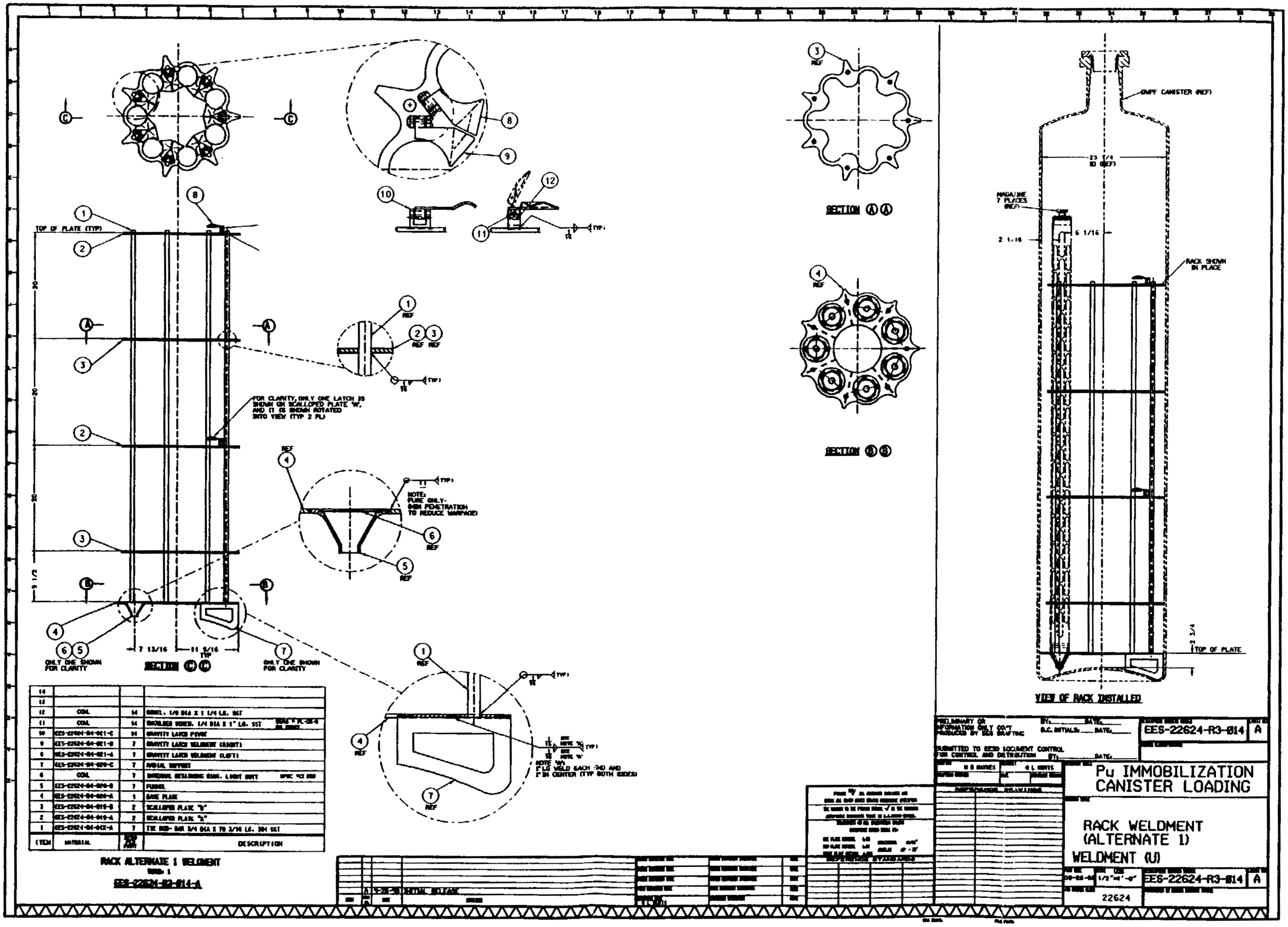
- Welded wire frame (like a shopping cart)
- Wire mesh
- Perforated pipe

SRTC prepared basic requirements and sketches for side and end loading magazines, then submitted them to 25 job shops specializing in wire frame, perforated metal and expanded metal fabrication, as well as general fabrication shops. (The requirements were kept basic to encourage vendors to use their own expertise and experience.) Five vendors submitted designs for 10 magazines: 2 perforated pipe end loaders, 2 perforated pipe side loaders, 1 wire mesh side

3. Manufacturing methods and tolerances for the magazine design are being evaluated.
4. Thinner wall sections for the magazine barrel are being tested.

REFERENCES

1. *Minutes of Can-In-Canister Concept Review,* E-mail from GL Hovis, Savannah River Site, Aiken, SC 29808 (12/17/97).
2. *Magazine & Canister Loading Technique,* E-mail from GL Hovis, Savannah River Site, Aiken, SC 29808 (1/5/98).
3. *Plutonium Immobilization Concept Magazine FEA*, PEC-EAT-98-0022, Savannah River Site, Aiken, SC 29808 (6/10/98).

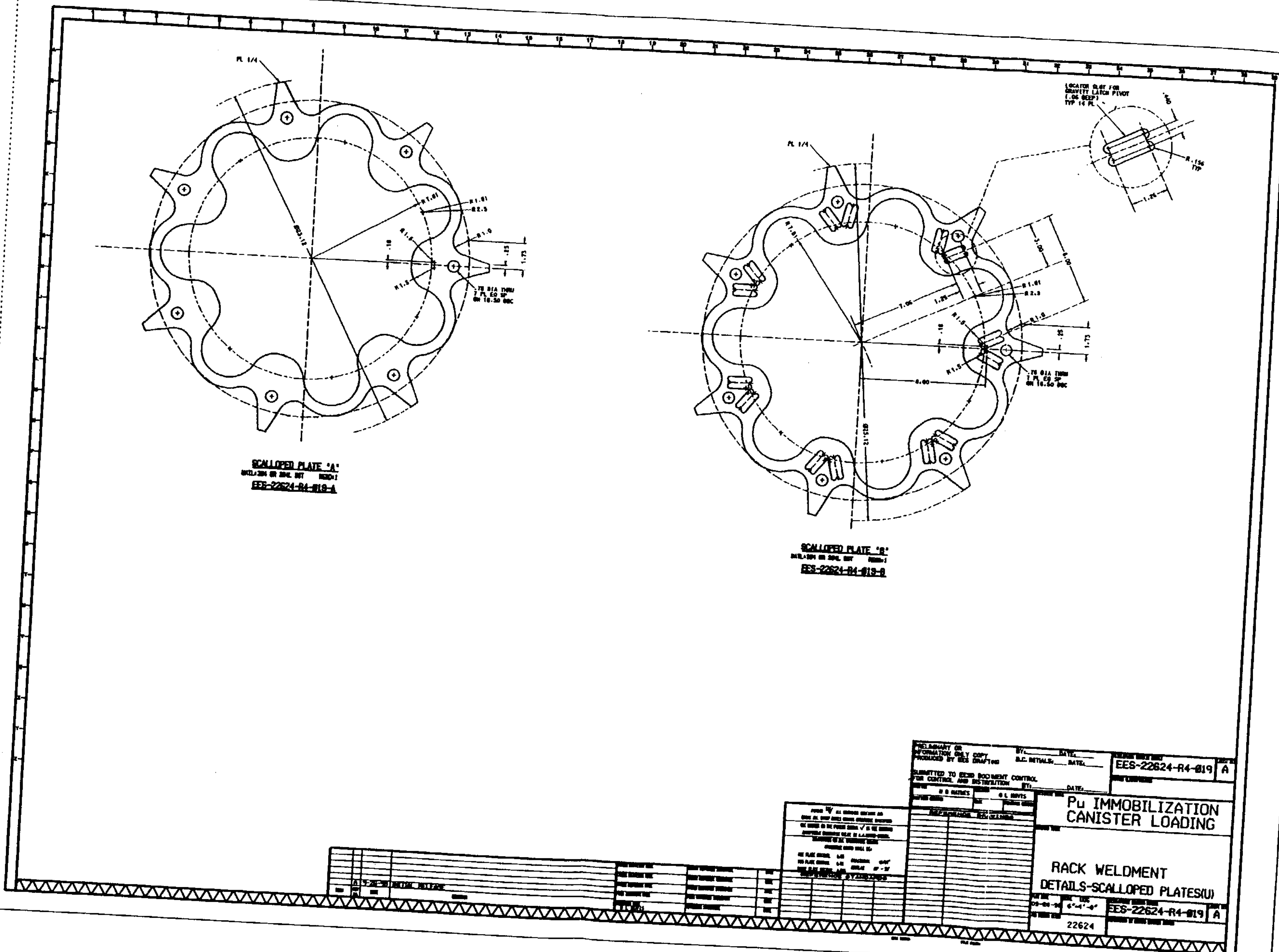


WSRC-TR-98-00333

ATTACHMENT 1

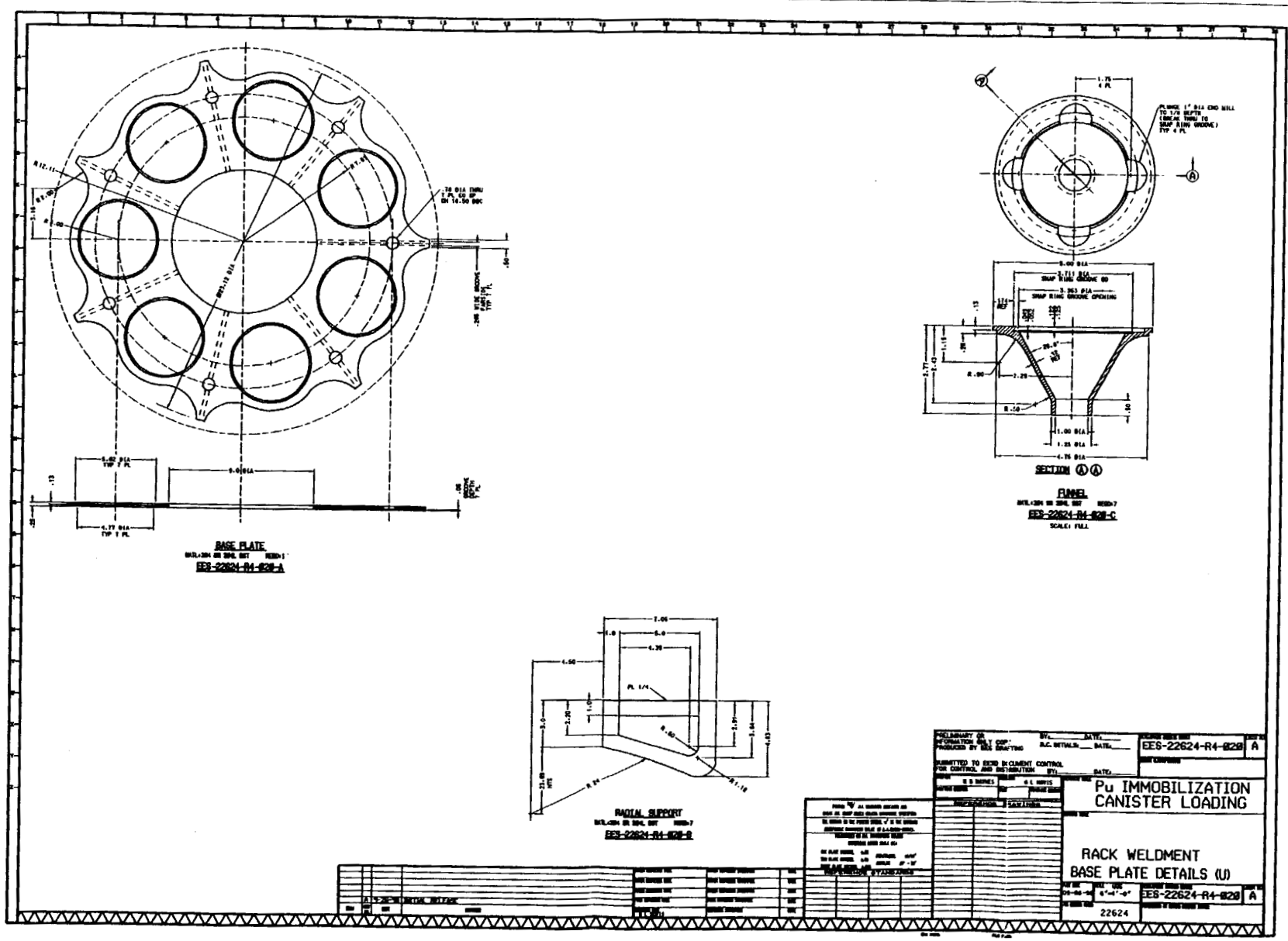
PLUTONIUM IMMOBILIZATION RACK AND MAGAZINE PRELIMINARY DESIGN (U)

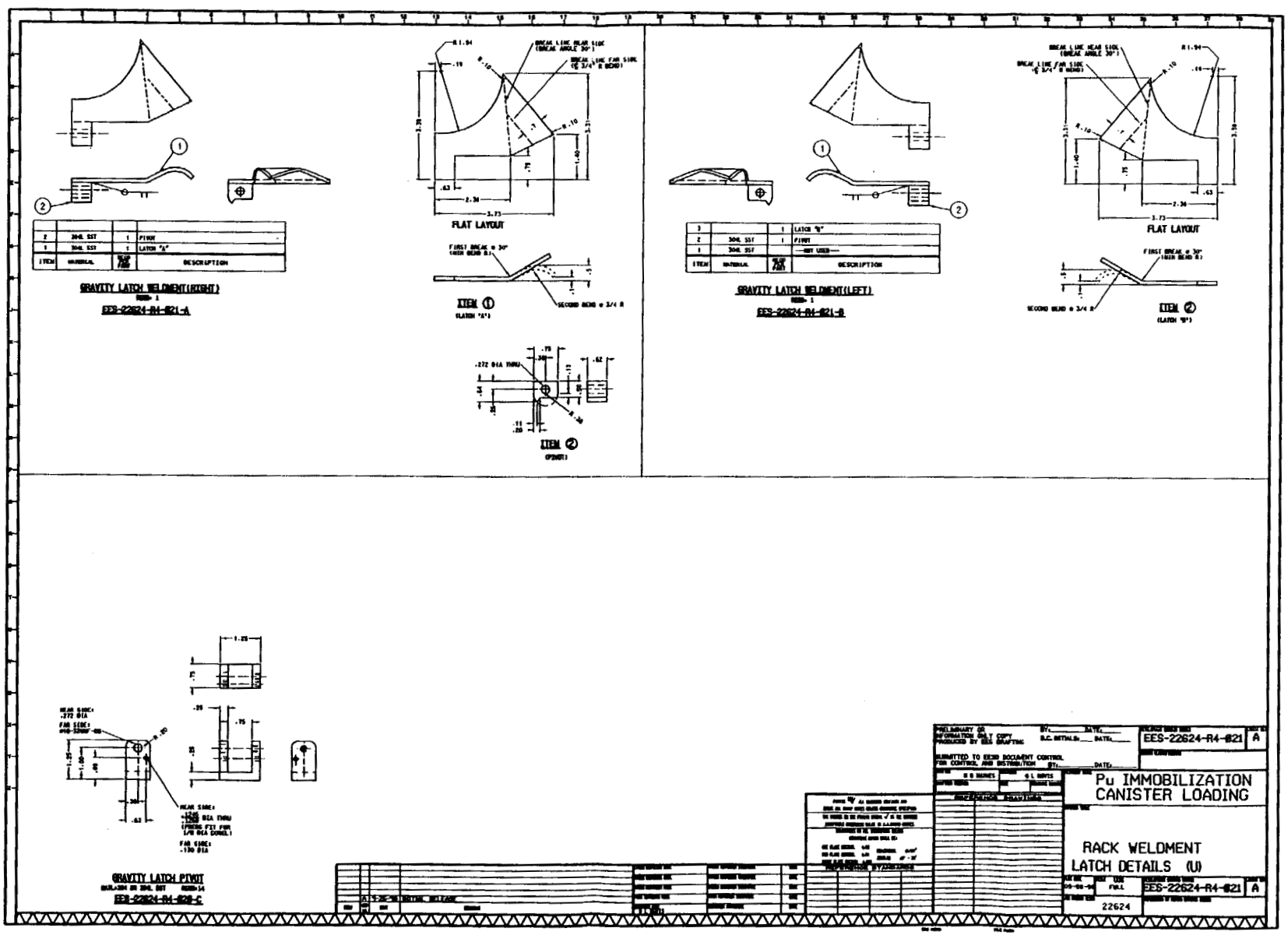
000109

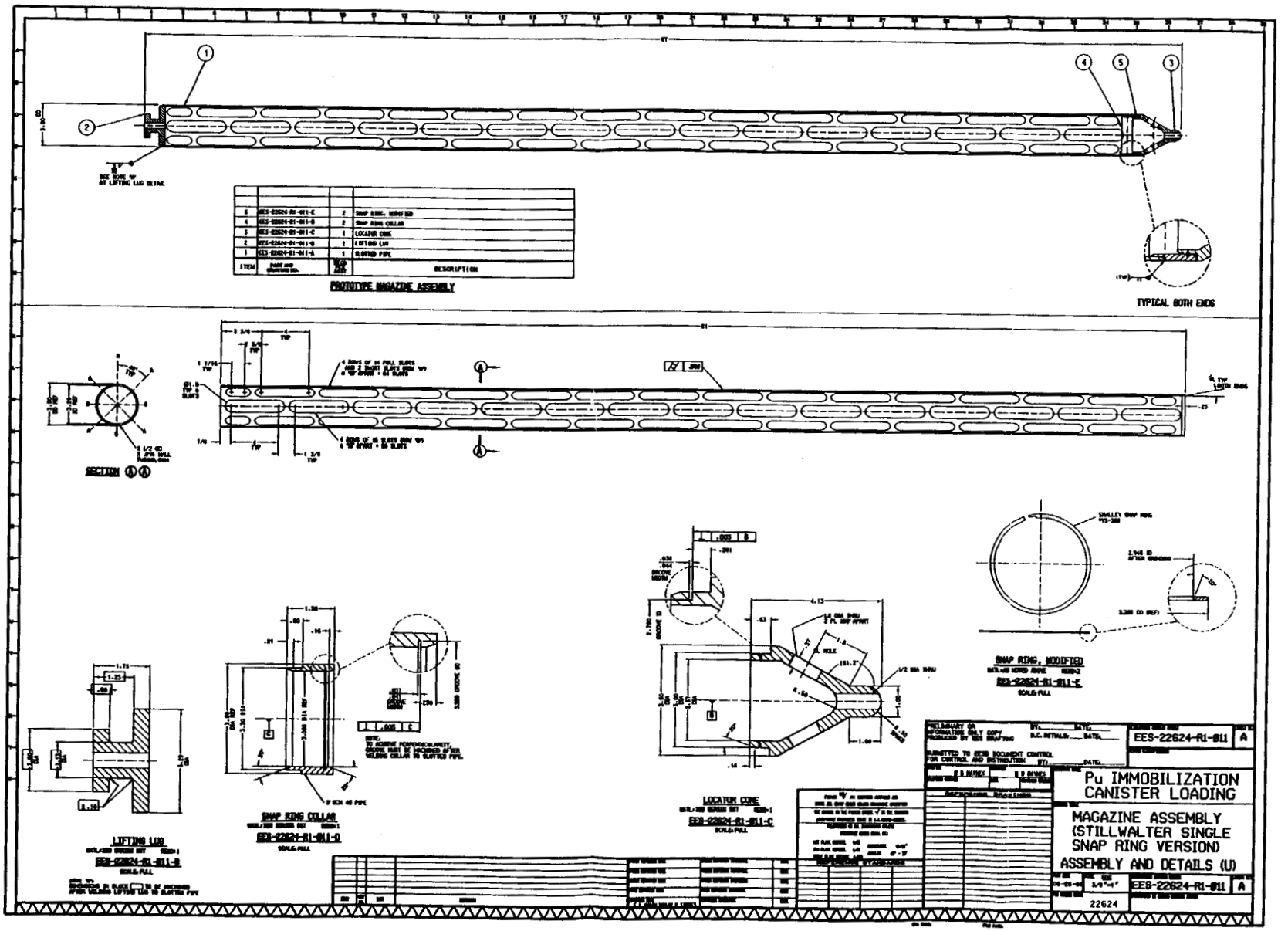


ATTACHMENT 2

PLUTONIUM IMMOBILIZATION RACK AND MAGAZINE PRELIMINARY DESIGN (U)


BASE PLATE
EES-22624-R4-028-A
SECTION A-A
FUNNEL
EES-22624-R4-028-C
SCALE: FULL
RADIAL SUPPORT
EES-22624-R4-028-B
Pu IMMOBILIZATION
CANISTER LOADING
RACK WELDMENT
BASE PLATE DETAILS (U)
EES-22624-R4-028
A
22624


GRAVITY LATCH WELDMENT(RIGHT)
EES-22624-R4-821-A
FLAT LAYOUT
ITEM ①
GRAVITY LATCH WELDMENT(LEFT)
EES-22624-R4-821-B
FLAT LAYOUT
ITEM ②
ITEM ②
GRAVITY LATCH PIVOT
EES-22624-R4-828-C
Pu IMMOBILIZATION CANISTER LOADING
RACK WELDMENT LATCH DETAILS (U)
EES-22624-R4-821
22624


PROTOTYPE MAGAZINE ASSEMBLY
TYPICAL BOTH ENDS
SECTION
SNAP RING, MODIFIED
LOCATOR CONE
SNAP RING COLLAR
LIFTING LUG
Pu IMMOBILIZATION CANISTER LOADING
MAGAZINE ASSEMBLY (STILLWALTER SINGLE SNAP RING VERSION) ASSEMBLY AND DETAILS (U)
EES-22624-R1-011
22624

Rev. "2"

0001109

Communication Distribution Routing Sheet
Plutonium Immobilization Project

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BOURCIER, B				**ANL**
BRONSON, M				CHAMBERLAIN, D
BRUMMOND, B	✓			
DI SABATINO, A	✓			**PNNL**
EBBINGHAUS,B				STRACHAN, D
GOULD, T				BARNES, B. Orie
GRAY, L				
JENSEN, L				
KAN, T	✓			
KERNS, J				
MACLEAN, L	✓			**DOE**
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RANKIN, T		✓		**DOCUMENT SUBJECT**
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				Ltr from Gould to Danker - PIR98-099
BECH				
LOFTUS, D				
MARAIS, B				

ADMIN. CONTACT: Jane Jarzo

ORIGINATOR / GROUP: T. Gould (Ltr)

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CCN Ref. Doc.

DOC. DATE: 9/30/98

DATE REC'D: 10/30/98

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QA ____ **NON QA** ✓

ATTACHMENTS ENCLOSED:
Yes ✓ No ____

COMMENTS:
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FMD Program
Plutonium Immobilization Project

Lawrence Livermore National Laboratory

October 29, 1998
PIP 98-099

Mr. William Danker, MD-3
Immobilization Project Manager
Office of Fissile Materials Disposition
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

Dear Mr. Danker:

Milestone Report for Second Stage Immobilization Task 7.1 Can in Canister Assembly

The attached report, *Canister Rack and Magazine Preliminary Design (U)*, WSRC-TR-98-00333, documents the Immobilization Program's preliminary design for the canister internal rack and magazine assembly employing a through the neck loading concept. This draft report is the deliverable for milestone 7.1.1b in the FY98 AOP.

If you or your staff have any questions regarding this evaluation, please contact me or Paul Maddux.

Sincerely yours,

Thomas H. Gould
Project Manager
Plutonium Immobilization Project

Attachment

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*Without attachment